# THE RESULTS

OF THE

# DESTRUCTIVE DISTILLATION

OF

# BITUMINOUS SUBSTANCES.

# A REPORT

PRESENTED TO THE

ANNUAL MEETING OF THE AMERICAN PHARMACEUTICAL ASSOCIATION AT NEW YORK,

SEPT. 10, 1860.

BY W. H. WHITMORE.

WITH

AN ESSAY ON THE HISTORY OF THE MANUFACTURE OF PARAFFINE OILS.

BY DR. FRANK H. STORER.

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# DISTILLATION OF COAL.

*To the Members of the American Pharmaceutical Association.*

GENTLEMEN:

At your last annual meeting, the subject of "the products resulting from the distillation of bituminous coal and allied substances" was assigned to me, on the understanding that the report was to consider the subject as a commercial question rather than a scientific one. After making some memoranda concerning the early history of the art of obtaining oil from coal, I learnt with pleasure that Dr. F. H. Storer of Boston, a gentleman admirably qualified for the task, had prepared an article for Silliman's Journal, and he has kindly allowed me to present a reprint of it as an appendix to this report.

I shall therefore refer you to that document for many interesting details concerning the development of the art, giving only a brief summary of his historical argument.

The distillation of coal, as is now well known, affords different products at different temperatures. At a high heat we obtain ordinary coal gas; at a lower heat, coal oil.

The practical manufacture of gas dates back only to 1792, when Murdoch commenced his experiments, though chemists had long previously distilled coal on a small scale. One branch of investigation which Dr. Storer has indicated will be of interest to the members of this Association.

"British oil" has long been in common use in England as a cure for rheumatic complaints, and it seems highly probable that we can show that coal oil was manufactured and used in pharmacy for nearly a century before its value as an illuminating agent was discovered.

In 1742, Michael Betton and Thomas Betton obtained a patent (No. 587 English Specifications) for "An Oyl extracted from a Flinty Rock, for the Cure of Rheumatick and Scorbutick and other Cases," in which they state "the material mentioned in the said Letters Patent, out of which the said Oyl is extracted, is the black, pitchy, flinty roch or rock which is commonly found lying next and immediately over the coal in coal mines, which said black pitchy flinty roch or rock is to be first pounded with hammers into powder, and then put into a furnace, covered down close with an head to it, and worked with fire, which will extract the said oyl from it."

Taken in connection with the citation from Lewis's *Materia Medica*, (3d App., p. 4,) we can well believe this patent to be the commencement of the manufacture of British oil, although the Pharmacopœia Bateana, published in 1696, and cited in "The Druggist," vol. 1, mentions *Oleum Carbonis* made by distilling sea coal in a glass retort.

In the Edinburg New Dispensatory, 1798, under the head of *Petroleum* or *Rock Oil*, we find that some deposits "are found in England, and many of our common bituminous minerals, as pit coals, &c., afford on distillation products not greatly different. An oil extracted from a kind of fossil coal has been cried up among the common people under the head of British oil for rheumatic pains." Of *Oleum Petroli*, the recipe is—"distill fossil tar, i. e. Petroleum, in a sand heat. . . . The oil appears blue when looked upon, but orange when held between the eye and the light."

We see, then, that the oil obtained from distilling coal was in use till the commencement of the present century, and it is still prescribed and used in the English provinces, and very probably in England.

An attempt has been made to confound coal-oil with coal-tar, but it will be evident that when coal is placed in a retort and distilled, for the purpose of obtaining an oil, that we must get such an article as comes off at a low heat. Without special information and care, the operator would, in following out the above directions of the Dispensatory, conclude that when his

retort was sufficiently heated to yield an oil, he had attained his object, and would preserve such a temperature as would maintain the production of oil. This oil could only be crude coal oil. There is no possibility of any other product, as coal-tar could not be considered an oil by any chemist seeking for a fluid resembling petroleum.

We may fairly assume that coal oil has been in practical use for certain purposes during the past century, and that pharmaceutists are entitled to the credit of first discovering its value, and availing of it.

A few points in Dr. Storer's report are enough to show the progress of chemists since 1830.

First. Reichenbach produces paraffine and paraffine oils from coals in 1831; Selligue obtains them from bituminous shales in 1834; Gregory, from petroleum, in 1834; Rees Reece, from peat, in 1849; Richard Butler, in 1833, from "schistus or shale, and slate, (not including slate coal,) and bituminous sandstone;" and George Michiels, in 1850, from "the coal of tertiary formation, for instance, Bovey coal, Kimmeridge coal, Brora coal," and, generally, bituminous coal.

One would think that all these different specifications must in some way include the principle of distilling bituminous coals.

In 1848, James Henry Staple Wildsmith obtainted a patent (No. 12,380 Eng. Sp.) for Improvements in the purification of Eupion and other matters; which Eupion he mentions as "obtained from shale or any other source."

In 1848, Prof. Walter R. Johnson published at Philadelphia an edition of Knapp's Chemical Technology, in which (i. 176) mention is made of Selligue's experiments and the report to the French Academy,—and we may feel assured that many readers of the book were tempted to make a trial of the process; a theory confirmed by several able chemists, who declare that in 1849 and 1850 they did distil coal and obtain oil.

Passing, however, from the question of the originator of the manufacture, we will consider the question solely as a commercial one.

Coal oil is obtainable from only a few kinds of coal, and until

recently the supply has been furnished exclusively by the Scotch mines. At the "GLENDON" factory we have worked experimentally, the Boghead and Bathville minerals; Albert coal, so called, Lesmahagow and Ince Hall cannel coals, Frazer coals, or shale, Ohio cannel, Virginia bitumen, and Pennsylvania and Canada petroleum.

The Boghead mineral we find yields the greatest amount of crude oil, as much as 137 gallons having been obtained on a careful test, though this amount of course largely exceeds the average yield. The Albert coal or bitumen yields about 85 gallons; Fraser coal, from Pictou, 40 to 65 gallons; Fraser shale, 18 to 35 gallons; cannel coals, 20 to 60; Virginia about 100; and petroleum, various amounts of market oil from 30 to 80 per cent.

The process of obtaining and purifying the oil is simple. The coal is distilled in retorts of iron, clay, or brick, and the oil is purified by repeated distillation in stills and by treatment with various acids and alkalis. The results are, an oil suitable to burn in the special kind of lamps now so generally in use, lubricating oils, paraffine, and benzole. Many other products will be hereafter applied to useful purposes, although the manufacturer now rejects them as unmerchantable. Brilliant dyes are obtainable from portions of the oil; carbolic acid, nearly identical with creosote, a valuable remedy for a certain class of diseases; even explosive compounds, analogous to gunpowder, are contained in those portions of the oil which we throw away as injurious to the burning oil.

Within the past year many changes have occurred in the business of manufacturing coal oil. The assignment and sale of the largest factory in the country, and the accumulation of imperfect oils in the large cities, combined to make capitalists afraid to venture their property in such enterprises, and created an undue prejudice against the business.

The recent discoveries of petroleum in this country has reawakened the spirit of speculation, and will very probably lead to renewed losses.

The exertions of rival manufacturers have resulted in placing

the standard for market oil so high that few can attain it; their different processes are known only to themselves; and owing to this necessary caution, we are unable to obtain more correct statistics and more extensive information upon the chemical questions involved in the art.

We are still ignorant of the point where coal becomes shale, and we are ignorant also of the origin of the oil contained in these substances. Boghead coal contains the impressions of vegetable forms, but it also contains shells and ripple-marks. Fraser coal, so styled, possesses no ferns or other vegetable remains, but resembles a mass of half-destroyed shells. Albert coal is like pitch, in color and lustre; Virginia coal seems like a bundle of minute iron rods; the New Brunswick shale is formed of numerous layers of bituminous substances, twisted and curved in fantastic forms; while to complete our confusion, Canada and Pennsylvania send us oil springing from the ground, but its source and nature remain unknown. The extensive investigations now being made must, however, supply many of the vacant spaces in the chain, and show the regular system to which they may be reduced.

The principal manufacturing companies are the three KEROSENE companies at New York, Boston and Portland. GLENDON at Boston, COLUMBIA at New York, and the GREAT WESTERN at Trenton, O. The NORTH-AMERICAN and LUCESCO Works at Pittsburg manufacture crude oil largely, and many small works in New York refine this oil and petroleum. The product of burning oil in New England, from June, 1859, to June, 1860, was about 500,000 gallons, and the New York Kerosene Company reported in February nearly an equal amount. The total product of all the factories in the country may be placed at about 1,250,000 gallons, and this amount will be largely exceeded by the present year's operations. The future magnitude of this branch of manufacture it is difficult to predict, but it would seem probable that inventive genius will devise some plan to make coal oil of service as a source of fuel, and we can then hardly place a limit to the demand for it.

I beg leave to annex a copy of the celebrated patent of James Young, Esq., as well as of Dr. Storer's Review, and to express my regret at my inability to report more fully upon the methods of purifying oil, and the action of different agents upon it.

W. H. WHITMORE.

# PATENT, NO. 8833.

*Granted Oct.* 7, 1850, *for* 14 *years, to James Young, of Manchester, England, for an "Improvement in making Paraffine Oil." Dated March* 23, 1852.

## SPECIFICATION.

To all whom it may concern.

Be it known, that I, James Young, of Manchester, England, have invented improvements in the treatment of certain bituminous mineral substances and in obtaining products therefrom, and I do hereby declare the following to be a full, clear, and exact description of the same.

My said invention consists in treating bituminous Coals in such manner as to obtain therefrom an oil containing paraffine, (which I call paraffine oil,) and from which oil I obtain paraffine.

The coals which I deem to be best fitted for this purpose are such as are usually called Parrot-Coal, Cannel Coal, and Gas Coal, and which are much used in the manufacture of Gas for the purpose of illumination, because they yield upon distillation at a high temperature, olefiant and other highly illuminating gases in considerable quantity; and although some coals last described contain a large amount of earthy matters, those matters do not interfere materially with the performance of my process.

To obtain Paraffine Oil from coals, I proceed as follows:—

The coals are to be broken into small pieces of about the size of a hen's egg or less, for the purpose of facilitating the operation; the coal is then to be put into a *common gas retort*, to which is attached a worm pipe passing through a refrigerator, and kept at a temperature of about 55° of Fahrenheit's thermometer, by a stream of coal [cold ?] water. The temperature of the refrigerator should not be made too low, lest the product

of the distillation should congeal and stop up the pipe ; and I find that a temperature of about 55° Fahrenheit is sufficient.

The retort being closed in the usual manner, is then to be gradually heated up to a low red heat, at which it is to be kept, until volatile products cease to come off. Care must be taken to keep the temperature of the retort from rising above that of a low red heat, so as to prevent as much as possible the desired products of the process being converted into permanent gas.

The coke or residue may then be withdrawn from the retort, which being allowed to cool down below a visible red heat, (to prevent waste of the fresh material to be introduced,) may be again charged with a quantity of coals, to be treated in like manner as I have described.

The crude paraffine oil distilled or driven off from the coals as a vapor, will be condensed into a liquid in passing through the cold worm pipe from which it will fall into a vessel which must be provided to receive it.

Instead of obtaining the whole of the paraffine oil by distillation or driving off as just described, a portion of it may in some cases, if thought desirable, be run from the retort, through an opening and pipe to be provided in the anterior and lower part of the retort for that purpose, after it has separated from the coal, and assumed a liquid form. I prefer, however, in every case to distil or drive off the whole of the paraffine oil to be obtained from the coal.

The production of the desired product from a charge of coals in a retort will be known to be finished by the liquid ceasing to run from the worm.

The crude product of this process is an oil containing paraffine, which, as I have already stated, I call paraffine oil. This oil will sometimes, upon cooling at a temperature of 40° Fahrenheit, deposite paraffine.

Other arrangements of apparatus may be used for subjecting coals to the process for obtaining paraffine oil therefrom as I have described, but I prefer to use the apparatus above mentioned as being well known and easily managed.

But in order to obtain the largest quantity of crude paraffine

oil from coals by means of this process, and produce the smallest quantity of permanent gas by the action of the heat employed, whatever may be the apparatus used, care must be taken to heat the coals gradually, and to apply the lowest temperature necessary to complete the operation. During the distillation or driving off which I have described, a permanent gas will be produced, and this gas may either be collected or suffered to escape as may be thought expedient.

I purify the crude oil obtained as already described, in the following manner:

I put the oil into a cistern and heat it (by a steam pipe or other means) to a temperature of about 150° Fahrenheit. When thus heated, water and undissolved impurities contained in the oil, will separate more readily from it than when cold, and the oil being left in a state of rest and kept warm for about a day, many of these impurities will fall to the bottom of the cistern, and the oil may then be run off into another vessel, leaving the residuum behind.

I then proceed to distil the oil, for which operation I prefer to use an iron still with a worm pipe connected to it, passing through a refrigeratory apparatus as before mentioned, the refrigerator being kept at or about the temperature of fifty-five degrees Fahrenheit, as I have already mentioned. I heat the still by a fire underneath it, which I keep up until the whole of the oil has been distilled over, and it will then be found that the still contains some dry carbonaceous residuum, which should be taken out before the still is again used.

The oil is to be run from the condensing apparatus as it distils, over, into a leaden vessel, where, to each 100 gallons, I gradually add 10 gallons of the oil of vitriol of commerce.

After this mixture has been well stirred for about an hour, I allow it to remain at rest for about twelve hours, so that the oil of vitriol and impurities with which it has combined may settle at the bottom.

I then draw off the supernatant oil into an iron vessel, and to each 100 gallons, I add four gallons of a solution of caustic soda, of a specific gravity 1300—water being 1000.

The soda and oil are stirred together for about an hour, so as to neutralize any acid which may remain in the oil, and also take up any impurities capable of combining with it, after which the contents of the vessel are allowed to remain at rest for about six or eight hours, so that the solution of soda may subside, and then the supernatant oil is to be drawn off and again distilled in the same manner as I have already described.

Paraffine oil obtained from the last mentioned distillation contains a fluid more volatile than paraffine, and I separate a considerable portion of this fluid from the oil, and obtain it in a separate state as follows:

I put the oil into an iron still, connected with a worm pipe passing through a refrigeratory apparatus, adding to the oil half its bulk of water, and boiling the contents of the still for about twelve hours, adding water from time to time, so as to keep about the same proportions of the oil and water in the still. The volatile fluid will pass over along with steam, and can be condensed in the worm pipe by the refrigeratory apparatus.

This fluid will be clear and transparent, and, as it is lighter than water, it separates on standing, from the water with which it will be mixed as it leaves the worm pipe of the still.

This fluid may be burnt for the purpose of illumination, or applied to any other useful purpose to which it may be applicable. The last named process will separate the greater portion of the volatile fluid I have mentioned, from the oil, but a larger quantity may be separated by prolonging the operation.

The oil left in the still after the completion of the process lastly described is then to be carefully separated from all the remaining water, (upon which it will float) and conveyed into a leaden vessel, where, to each 100 gallons, I add two gallons of oil of vitriol.

This mixture is to be well stirred for six or eight hours; after which I allow it to stand undisturbed for twenty-four hours, in order that the vitriol may settle to the bottom of the leaden

vessel, carrying with it all impurities with which it has combined.

The supernatant oil is now to be drawn off into another vessel, and to each 100 gallons there is added 28 lbs. of chalk ground up with a little water into a thin paste. The oil and chalk are then to be well agitated until the oil becomes freed from sulphurous acid. This oil is to be kept warm, say at 100° Fahrenheit, in any convenient vessel for about a week, to allow impurities to settle, and it is then fit to be used for lubricating purposes, either by itself or mixed with an animal or vegetable oil, or it may be burnt by itself in Argand lamps for the purpose of illumination, and this oil may be farther purified if required by distilling it over again.

To extract paraffine from the purified paraffine oil obtained in the manner I have described, the oil is to be cooled to a low temperature, say to 30° or 40° Fahrenheit, and the lower the temperature the larger will be the quantity of paraffine separated from the oil. In this way paraffine is made to crystallize, and in this state it may be separated from the oil by filtration through woollen or other cloths, and then squeezing it in a powerful press, by which means it will be made sufficiently pure to be used for lubricating and some other useful purposes.

But the paraffine may be farther purified if required by treating it several times at a temperature of about 160° Fahrenheit, alternately with its own bulk of oil of vitriol, and with a similar quantity of a solution of caustic soda (of the specific gravity already mentioned), until the paraffine ceases to render the oil of vitriol black. It is then to be washed in a weak solution of soda, and lastly with boiling water, until the water ceases to change the color of red litmus water.

To obtain paraffine from paraffine oil, I sometimes put the oil into a still and distil over one half or more of its contents. The portion then remaining will contain a much larger proportion of paraffine than the paraffine oil put into the still contained. This residue being then distilled over into a separate vessel and allowed to cool, paraffine may be separated by filtration and

squeezing in cloths, and also purified by treatment with oil of vitriol and soda as before described.

Paraffine oil, from which paraffine has been separated as above described, still contains paraffine in solution, and is suitable for lubricating or lighting purposes, as already mentioned.

What I claim as my invention, and desire to secure by Letters Patent, is the obtaining of Paraffine Oil, or an oil containing paraffine, and Paraffine from bituminous coal by treating them in manner hereinbefore described.

Signed JAMES YOUNG.

# THE HISTORY

OF THE

# MANUFACTURE OF PARAFFINE OILS.

BY DR. FRANK H. STORER.

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# REVIEW OF Dr. ANTISELL'S WORK ON PHOTOGENIC OILS, &c.

[The following Review of Dr. Antisell's book on Photogenic Oils has been for some months in type waiting an opportunity when our other engagements would permit its publication. It will amply repay the careful perusal of all who are interested in this important practical subject.—EDS.]

## REVIEW.

1. *The Manufacture of Photogenic or Hydro-Carbon Oils from Coal and other Bituminous Substances capable of supplying Burning Fluids;* by THOMAS ANTISELL, M.D., Professor of Chemistry in the Medical Department of Georgetown College, D. C., etc. etc. New York and London: D. Appleton & Co. 1859. pp. 144.—In entering an earnest protest against the work before us, we would not have our motives misunderstood. We are not of those who would condemn a book solely on the ground that it is "not so good as it should be," and will not therefore urge this objection against the effort of our Author, although it would be hard to find a case to which the charge would more forcibly apply. But we do condemn most heartily the presumption of the man who in these days attempts to write a handbook upon any scientific or technological subject with which he is not somewhat familiar. We believe, moreover, that errors, either of omission or of commission—accidental or intentional—in scientific writings, which exceed the well-understood conventional limits of *tolerance*, should not be allowed quietly to pass without correction.

Dr. ANTISELL, from his position of chemical examiner in the Patent Office at Washington, has naturally had a rare opportunity of familiarising himself with the recent improvements which have been made—or claimed—in the manufacture of coal oils. In the work in question, he has published an index of these, which cannot but be acceptable to all who are interested either in the practical or scientific consideration of the subject. Had this list been published by itself, or had it been incorporated with a portion of the materials which Dr. A. has now exhibited, in an article, or a short series of articles, in some one of our scientific or technological magazines, it would have been most gratefully received, and, we doubt not, widely copied. Diluted and scattered as this information has been, however, that it might fill a volume, its value has been lessened in no slight degree.

We have endeavored, in vain, to make out the point of view from which the Author regarded his subject. Claiming the attention of all persons engaged in the manufacture of liquid products from the distillation of mineral combustibles, his work is nevertheless not a didactic one. In it scarcely any attempt is made to instruct the manufacturer, either by a clear enunciation of general principles to be followed, or of special details to be observed in given cases;* while a most lamentable lack of familiarity with the chemistry of the subject is continually exhibited throughout the work. Indeed the book is simply a jumble of badly selected extracts, huddled together in a manner which must be anything but edifying to the student. As a compilation, it has the merit of directing attention to a number of sources from which valuable information may be derived; while it has the great fault of omitting to mention numerous other sources of knowledge of equal or of greater value.

In several instances, moreover, erroneous assertions are made, or wrongful conclusions drawn. One or two of these we propose to discuss and correct

* In this respect our author has fallen far below the level attained by previous writers upon the subject. Compare for example: UHLENHUTH, *Handbuch der Photogen-und Paraffin-Fabrikation.* Quedlinburg Basse, 1858.

in this article. Our attention will be especially directed to the first chapter of Dr. Antisell's book—"History of the Art"—for in it are errors which have too long been current in the annals of chemical science—errors, the repetition of which by our author is the more unpardonable, since, from his very position, he should have known them to be such. Indeed, from statements to be found in various parts of his work, it would appear that he must have known of these errors—that he must have been in possession of most of the facts which will here be brought forward.

That we may form a correct notion of the subject under discussion, let us here digress for a moment.

As a general rule, when any bituminous substance is subjected to distillation—in the ordinary acceptation of the term, *i. e.*, when it is gradually heated in any appropriate apparatus, a quantity of an oily fluid is produced, which may be collected in receivers; small quantities of gas, water, and other incidental products being at the same time obtained.

The oily liquid, which alone interests us here, known in this country as *crude coal oil*, is a mixture of various hydrocarbons, among which the wax-like substance Paraffine is an almost never-failing constituent. Crude oil, though of course varying greatly, according to the sources from which it is derived, like the various marketable "coal oils" obtained from it by purification, is specially characterized by its low specific gravity, being capable of floating upon water.

When, on the other hand, a bituminous substance, instead of being gently and gradually heated, is suddenly exposed to the action of an intense heat—when, as in the ordinary process of gas-making, it is thrown into vessels of iron or clay, which have *previously* been brought to a bright red heat, a different set of products is obtained. A large quantity of permanent gas is produced, while the liquids formed are no longer the light oily compounds just spoken of, but are composed of another set of hydrocarbons which taken collectively, are *heavier than water*. These constitute coal-tar. Among them paraffine is no longer found, excepting in comparatively rare instances, another solid substance, Naphthaline, being a characteristic component of the mixture. When the process to which the bituminous matter is subjected is a mixed one, *i. e.*, when a portion of the substance comes in contact with strongly heated surfaces, while other portions receive only an amount of heat sufficient to distill off oils of the kind first described, a mixed product, containing both coal-oil and coal-tar, is naturally obtained. As an instance of such mixed product may be mentioned the tar obtained in the preparation of gas from Boghead coal,* it being almost impossible, in this case, to maintain the retorts at the temperature best suited for gas-making, on account of the great amount of heat which is rendered latent by the enormous volume of gas generated by this highly bituminous substance.

It should be mentioned, that both crude coal-oil and coal-tar contain a quantity of "light stuff," composed of several exceedingly volatile and inflammable liquids. Some of these naphtha-like fluids, for example benzol—the benzine of the French—(known as *benzole* in the private vocabulary of Dr. Antisell, or that of his proof-reader)—may occur both in crude-oil and in tar; others do not. We refer to these "light-stuffs" here merely for the purpose of explaining that they have been at times spoken of as "volatile oils," from the resemblance which they bear to spirits of turpentine and other essential oils, and to eliminate them from the discussion. They are of but minor interest at the present moment, when compared with the true "coal-oil" now so largely employed in this country. We may mention, in passing, that Dr. Antisell has very inconsiderately obscured his historical sketch of the progress of the art of distilling coal-oil

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* In the same class are several Scotch cannels, our own Breckenridge and allied coals, also the Albert coal of New Brunswick and the like.

by blending with it the question of coal-tar naphthas. He has, for that matter, been unfortunate throughout in the presentation of this part of his subject; all the crude liquid products of distillation, at whatever temperature the process has been conducted, being indiscriminately classed by him as *tar*. Now, it is well known to practical men, as has already been described, that the products obtained from bituminous matters by slowly distilling them, is as different from coal-tar as ether is from alcohol. The term crude-oil, by which the first-named liquid is known to manufacturers in this country, characterizes it perfectly; so does the term *huile de schiste* (written at times simply "*schiste*") of the French.*

It is surprising that Dr. Antisell should have followed the example of several German authors—without their excuse—in thus perplexing his readers.

In returning from this digression, we would expressly declare our disbelief in the adage which allows for the existence of no novelty. Still we do believe that very few of the arts have sprung into existence in a day, their perfection, and especially their development, having almost always resulted from the successive labors of numerous individuals; and we do believe that the inventor, who first practically "applies" any abstract knowledge, and thus creates a new art or branch of industry, is entitled to credit therefore—and to far more credit, and that of a different order, than the man who subsequently introduces this art into a foreign country. We would not detract from the efforts of the latter; on the contrary, would accord them high praise; but we desire, first of all, to see justice meted out to him who created the art—to those who increase human knowledge, sooner than to its mere diffusers.

We would therefore join issue with Dr. Antisell when, in his preface, he tells us that his book is a "record of the origin and condition of an infant art," and again mentions "this new branch of industry." So, also, in the first lines of his Historical Introduction, where he speaks of "the new and extensive manufacture of oils from coal and other bituminous substances." For these statements are not only erroneous in themselves, but they—no less than the unfair allusions which appear on subsequent pages—tend to do great injustice to earlier inventors, and especially to the memory of a man whose name must ever remain inseparably connected with the history of the *art* of manufacturing the fluid now known as coal or paraffine-oil. We refer to Selligue. More than twenty-five years ago, this inventor's method of obtaining such oil was described in the *Journal des Connaissances Usuelles*, for Dec., 1834, p. 285. (See also *Dingler's Polytechnisches Journal*, 1835, lvi, 40.) This article was subsequently followed by numerous others, until in Selligue's patent of March 19, 1845, we find the whole subject treated of most fully and clearly. As a lucid and truthful description of his processes and of the products obtained, this specification is most praiseworthy. Few subsequent writers upon the subject have been able to add anything to the stock of knowledge which it imparts. Taken for all in all, it is doubtless the most meritorious essay which has ever been published upon the art of manufacturing coal-oil. We can but reiterate our statement, that the brief, inaccurate, and exceedingly superficial comments which have been bestowed by Dr. A. (pp. 9, 80, etc.) upon the information which Selligue has imparted in his admirable series of essays, does great injustice to the subject as well as to this author.

Leaving for a moment the minute consideration of Selligue's improvements, let us first glance at the labors of some of his predecessors.

As Dr. Antisell has truly said (p. 7), the discovery of the production of oil from coal appears to date as far back as the time of Boyle, (1728–1799), when the well known experiments of Dr. Clayton were made.†

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* We may here observe, that throughout this article we shall translate the French term *huile de schiste*, by its English equivalent, *coal-oil*.

† Philosophical Transactions, Jan. 1739, No. 452, p. 59; in Martyn's Abridgment, vol. ix. p. 395.

In distilling coal from a pit near Wigan in Lancashire, this observer obtained, first phlegm (water), then oil, and finally gas.

No doubt an earlier record of similar experiments might be found in the writings of the alchemists, who, as is well known, subjected almost every substance to processes of distillation.

During the last century attention was again several times called to the fact.*

It would seem, however, that nothing very definite was published before the year 1830. UNVERDORBEN† had, indeed, in the preceding year, called attention to oils distilled from petroleum, and even appears to have obtained paraffine—to which however he gave no name.‡ The attention of the scientific world was first really attracted to this substance by the memorable memoir of Reichenbach,§ who separated it, in the first instance, from wood tar, and described its properties at length. In the following year, Reichenbach‖ is at great pains to prove that the crude-oil, obtained by slowly distilling coal, contains no naphthaline,¶ that naphthaline is not a product of the slow distillation of coal, but is a result of the subsequent decomposition of such products by heat; and that the coal-tar of gas-works is not crude-oil, but an impure mixture of the products of distillation with those resulting from their decomposition.**

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* In addition to the authorities cited by Dr. A. (p. 8), we would mention the following from *An Experimental History of the Materia Medica, or of the Natural and Artificial Substances made use of in Medicine;* by WILLIAM LEWIS M.B., F.R.S., 3rd Edit. 8vo, Dublin, MDCCLXIX, vol. ii, p. 143, Article *Petroleum;* also, (according to American Druggists' Circular, iv, 36,) in the London edition of Lewis. 4to, 1761, p. 436:

"Some mineral oils, procurable among ourselves, are used by the common people, and often with benefit. The empirical medicine, called British oil, is of the same nature with the petrolea; the genuine sort being extracted by distillation from a hard bitumen, or a kind of stone coal, found in Shropshire and other parts of England."

† *Berzelius's Jahresbericht*, x, 181, from *Kastner's Archiv*, xvi, 122; also in *Schweigger-Seidel's Journal für Chemie und Physik*, 1829, lviii, 243.

‡ For allusions to other earlier German researches bearing upon the subject, see Reichenbach's Memoirs, which will be cited directly. Compare also Gmelin's Handbook of Chemistry (Cavendish Soc. Edit.), xii, 439.

§ *Journal für Chemie und Physik*, (or *Jahrbuch der Chemie u. Physik, Band*, xxix) *von* Schweigger-Seidel, 1830, lix, 436.

‖ *Ibid*, (or *Neues Jahrbuch der Chemie u. Physik*, B. 1,) lxi, 175.

¶ Dr. Antisell dismisses this article (p. 11) with the statement that "in 1830-'31, Reichenbach discovered naphthalin." It may not be amiss to state that naphthaline was discovered at least ten years earlier, having been described by GARDEN in 1820 (Thomson's *Annals of Philosophy*, xv, 74), to whose labors as well as to those of CHAMBERLAIN, KIDD, and others, Reichenbach particularly refers in this very article. See also *loc. cit.* B. lxviii, [B. viii, of the "*Neues-Jahrbuch*,"] S. 233.

** It must here be explained that Reichenbach has suffered great injustice at the hands of those who, in translating portions of his papers, have rendered his term "*Steinkohlentheer*" literally—coal-tar. Now the term coal-tar, in countries abounding in gas-works like England or the United States, means the tar of gas-works, and it means nothing else. Gas-works, it must be remembered, were, until quite recently, by no means so common in Germany, and were doubtless rare enough in 1830, consequently, it is not at all strange that the English idea of "coal-tar" should not have become current in that country. Reichenbach, for that matter, distinctly and repeatedly asserts, that his "*Steinkohlentheer*" is a very different substance from the tar of gas-works. In a word, it was *crude-oil*. If, perchance, there may be any person who would accuse us of mistranslating certain *words* used by Reichenbach, we would at once refer such an one to the orginal memoirs of this author. Submitting it to the judgment of any competent chemist, whether we have misinterpreted his lan-

These experiments were made upon a manufacturing scale, Reichenbach being, at this time, "chief of an extensive system of mines, iron furnaces, machine shops, chemical works, etc., most of them established by himself on the estate of Count Salm [Blankso, Moravia]. These works lie along a line some fifteen miles [5 *Stunden*] in length." (Schweigger Seidel).

In another article published later, in 1831,* he describes his method of obtaining paraffine from the distillation of flesh and of *coal* (portions of 75 lbs. weight having been operated upon). With regard to coal, he particularly urges the necessity of slow distillation, in order to prevent the decomposition of the first products and the consequent formation of naphthaline, as explained in his previous article, to which he refers. The paraffine was separated from the less volatile portions of the rectified oil by cooling—the description of which oil R. reserves for a separate article.† He also obtained paraffine from petroleum. Two more papers upon the subject were published by Reichenbach in this year,‡ only the first of which is of particular importance in this connection. It relates to *Eupion* (εὖ very, πίον fat). A term by which Reichenbach designates, in some instances, a portion, in others the whole of the somewhat difficultly volatile, fat-like oils, prepared by purifying the first product obtained by slowly distilling substances of animal or vegetable origin. This eupion was, in fact, a mixture of several hydrocarbons—the same which, in similar mixtures, are now collectively known in commerce as coal-oil; called paraffine oil by some, and designated in the retail trade by innumerable other names of only local significance.

Eupion was obtained by Reichenbach from the products of the slow distillation of animal and vegetable substances, as well as from coal, and was minutely described by him. We make but a single extract from this article, which occupies some thirty-two pages: "When any one shall succeed in separating eupion, at a sufficiently cheap rate, from the tars [crude-oils], it will very probably enter into the circle of substances useful in household economy. For, since it burns from a wick, brightly and clearly, and is free from smoke, it is in no wise inferior to the finest oil as an illuminating material. It does not grease nor crust the wick, nor stiffen when cold. If we consider, in addition to this, that for all purposes where cold can exert no influence, the paraffine need not be separated, but can be left dissolved in the eupion, and used in conjunction with it for lighting; we shall perceive that this is of some importance, since the two substances are thus mutually improved for technical purposes."

In 1832, Reichenbach§ again published a note upon eupion; and, in 1834, another long article,‖ in which he once more dwells upon its useful properties.

Reichenbach's contributions on the subject of the dry distillation of organic substances, are comprised in some twenty or more long articles, not counting

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guage, [compare, for example, *loc. cit.*, B. lxviii., [B. viii, of the *Neues-Jahrbuch.*,] S. 226].

It may be worth while also to call the attention of the reader to the fact that all of the substances discovered by Reichenbach in "tar" (as the text-books tell us) were in reality obtained from crude-oil. Knowing this, every one familiar with recent chemical literature, will perceive at once why so few of R.'s scientific results have been corroborated. For, until quite recently, the attention of chemists interested in such researches, has been almost completely occupied with the subject of coal-tar. Compare also Reichenbach's complaint against Dumas and Laurent, in Schweigger-Seidel's *Journal für Ch. u. Phys.*, 1838, lxviii, 223.

* *Loc. cit.*, lxi, [or B. 1, of the *Neues-Jahrbuch*], S. 273.

† *Vid. infra.*

‡ *Loc. cit.*, lxii, [or B. ii. of the *Neues-Jahrbuch*], S. 129, 273.

§ *Loc. cit.*, B. lxvi, [B. vi. of the *Neues-Jahrbuch*], S. 318.

‖ Erdmann's *Journal für praktische Chemie*, i, 377.

several smaller "notes." A tolerably complete list of which may be found in Erdmann's Journal für praktische Chemie, i, 1. It is very much to be regretted that these memoirs have never been collected and published as a separate volume. Even now, any chemist who could find time to collect these scattered articles and translate them into English or French, would unquestionably promote the cause of science by so doing.

Looking at the question for a moment, solely in its scientific bearings, we cannot refrain from an expression of astonishment, that the details of Reichenbach's researches are so little known to the generality of chemists;* while, on the other hand, we are forced to confess, that it is indeed rare that scientific researches, conducted by a chemist in his laboratory, have so fully described a future art—have so accurately pointed out the methods to be followed and precautions to be observed by the practical manufacturer. We must not omit to mention that, in 1831, Christison† of Edinburgh made known his discovery of paraffine in petroleum from Rangoon. Not knowing of Reichenbach's previous publication, Christison named it *Petroline*, but subsequently admitted its identity with paraffine. In 1833, Bley‡ distilled oils from lignite.

A little later, in 1834, Gregory§ published an able article upon paraffine and eupion, and their occurrence in petroleum. Of this memoir we cite but two lines, (vid. Trans., p. 129, or Rep, p. 113). "It follows," says Gregory, "that there are some kinds of naphtha [petroleum] which contain paraffine and eupion, and are consequently the results of destructive distillation."

In the following year, v. Kobell‖ also noticed paraffine in petroleum.

For the labors of Hess in Russia, and of several other chemists in Germany, as well as for the interesting discussions which followed between these

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* This lack of information appears to depend upon the circumstance, that the writers of most recent chemical text-books seem to have derived their knowledge of the subject in question, from Gay Lussac's brief abstract of Reichenbach's earlier memoirs, which was published in 1832, in Poggendorff's *Annalen*, xxiv, 173; also in the *Annales de Chimie et de Physique*, [2], 1, 69; and quite extensively copied by the journals of the day.

In this connection we would respectfully urge upon all those who have fallen into the common habit of regarding as somewhat apochryphal the numerous substances of greater or less scientific interest, which Reichenbach separated from the products of dry distillation, that before seeking to discredit—or allowing themselves to disbelieve—them, they should conduct experiments similar to his, *on a scale of equal magnitude.* Let us here also bear in mind the luminous conclusion of the late Dr. Hope of Edinburgh, who, as the story goes, (Vid. London Chemical News, i, 56), one day informed his class that Reichenbach had discovered in tar, "creosote, picamar, paraffine, cedriret, capnomor, and a host of other substances of no interest or importance whatever." Of these "unimportant" substances, two at least, eupion and paraffine, are to-day as well known, in the world, as bees-wax or spermaceti, although comparatively little—we had almost said nothing—has been added to the scientific knowledge of them, since the publication of Reichenbach's memoirs. If, perchance, any other of these well-nigh forgotten bodies should be found to possess any technical importance, we would quickly enough find some one claiming credit for its "discovery," and oppressing chemical nomenclature, by adding yet another name to the existing "host." Even now we await, with no little interest, the elucidation of the question—whether the new violet dye, prepared by oxydizing anilin, which is exciting so much interest, under the names anilein, Perkin's purple, *mauve*, etc., is not identical with, or a component of, the *pittical* of Reichenbach.

† Transactions of Royal Society of Edinburgh, xiii, 118; also in Repertory of Patent Inventions, 1835, [N. S.] vol. iii, p. 390.

‡ Schweigger-Seidel's *Journal für Chemie u. Physik*, B. lxix, [B. ix, of the *Neues-Jahrbuch*], S. 129.

§ *Transactions of Royal Society of Edinburgh,* xiii, 124; also in *Repertory of Patent Inventions* 1835, [N. S.] vol. iv, p. 109.

‖ J. pr. Chem. v. 213.

observers and Reichenbach, the reader may consult the general index [Namen-u. Sach-Register zu den Bänden i. bis lx, Leipzig, 1845] to Poggendorff's Annalen der Physik u. Chemie.

At the same time that these scientific researches were in progress in Germany and Scotland, or even earlier, numerous practical efforts to manufacture oils from bituminous substances were made in France.

Although the precise date at which these experiments were commenced is somewhat obscure, it will not be difficult to trace the history of the successful development of the industry to which they gave rise.

As stated by Dr. Antisell, the MM. Chervan* had a patent, dated in 1824, for distilling bituminous substances. Blum and Moneuse,† in 1832, claim only the application of coal-oil to purposes of lighting—not its manufacture, which they allude to as being well known.

Subsequently (7th October, 1833) Boscary‡ obtained a patent for extracting pyrogenous oil from different substances, asphaltums, etc., and especially from the shales which occur in the environs of Autun (*Saone* et *Loire*), and finally from all the bituminous matters in France. The oil, which is obtained by distilling the shale in metallic cylinders, may be used, according to Boscary, instead of fish-oil or resin, for gas-making—a much better gas than that prepared from coal being thus obtained.

In 1833, Laurent§ occupied himself with the investigation of various bituminous shales, both French and English, at the instance of the MM. Blum, whom he mentions as being occupied with the distillation of oil from the shales of the environs of Autun.‖ Laurent gives the details of the process employed by himself, telling us that the retort in which his shales were distilled attained a sombre red heat at the close of the operation; also of the percentage amounts of oil (20 p. c.), gas, coke and water obtained from the Autun shale; how the oil cannot be burned in ordinary lamps, on account of smoking, but affords a very luminous flame when consumed in lamps furnished with suitable chimneys. He shows moreover that the oil contains paraffine, and does not contain naphthaline.

Laurent subsequently published another paper¶ upon this oil, in which article he records his efforts to ascertain what definite chemical compounds are contained in the oil. One of the products obtained by fractional distillation, viz., an oil boiling at 167° to 170° (C.) = 333° to 338° F., he considers as identical with eupion.

In 1834, we find, for the first time, an article** describing the process of Selligue, although it would appear from the statements of this chemist and of others, that his attention had been directed to the subject of distilling bituminous shales several years earlier. The cited article relates how the shale is *slowly* distilled in iron cylinders, until no more oil comes over; how the oil obtained is characterized by containing neither oxygen nor naphthaline, but a solid substance differing from the latter, and resembling that called paranaphthaline†† by Laurent.

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* Brevets d'Invention xviii, 232. † *Ibid.* lxv. 250.

‡ *Ibid.* lxviii, 359.

§ *Annales de Chimie et de Physique*, liv, 392.

‖ According to Laurent, he had himself proposed to a company, in 1829, to work these shales, in order to extract the oil contained in them, and to employ it for lighting.

¶ *Comptes Rendus*, 1837, iv, 909; more fully in *Annales de Chimie et de Physique*, lxiv, 321.

** *Journal des Connaissances Usuelles*, Dec. 1834, p. 285; also in Dingler's *Polytechnisches Journal*, 1835, lvi, 40, from which our extract is taken.

†† The inadvertency of confounding this body with paraffine was subsequently corrected by Selligue.

In 1834, '35 and '36, Selligue* was principally occupied with his well-known process for making water-gas. In calling the attention of the French Academy† to this, he remarks that, in conjunction with David Blum, he holds a patent granted in 1832 for the application of oils obtained from shale to purposes of direct illumination, and that the working of the shale employed is in the hands of a company capable of developing the business to any extent which commerce or the arts may require.

In the same year Payen,‡ in reporting upon Selligue's water-gas, remarks upon the great importance of the new industry of distilling oil from shales which S. has introduced.

In the following year we again find Selligue before the Academy§ requesting that body to appoint a committee to examine the merits of his new system of gas-lighting; his process of distilling bituminous shales on the great scale by means of apparatus. each one of which furnishes from 1,000 to 1,400 pounds of crude oil per day—this being about 10 per cent of the weight of the shale employed, and being almost all which exists in the raw material; also of his process of separating various products from the crude oil, some of which are applicable to the production of gas, others to ordinary purposes of illumination, and others to different uses in the arts. This petition was referred to a committee of three—Thenard, D'Arcet and Dumas—who reported in 1840.‖ They mention the localities of Selligue's three establishments for obtaining oil from shales; the amounts of oil obtained from the different kinds of shale, &c.

In 1838 Selligue also obtained a new patent¶ "for the employment of mineral oils for lighting." In his specification he informs us that the principles upon which his processes for rendering the oil obtained from shales proper for the purposes of direct** illumination depend, are:

I. Removal of almost all odor. II. Removal of all tar. III. Removal of the most volatile portions of the oil, which are also the most inflammable and the most odorous, the presence of which would cause the oil to have too great fluidity for the capillarity of ordinary wicks. * * *

The operations, continues Selligue, consist in slowly distilling the bituminous shale, and collecting the liquid products in large receivers. These products are redistilled, and divided into fractions by refrigerating. They are treated with concentrated sulphuric acid for a longer or shorter time according to the nature of the shale employed. Twenty-four hours are ordinarily sufficient, the oil being agitated from time to time. The quantity of acid used varies from $\frac{1}{10}$ to $\frac{1}{20}$. After this the oil is to be carefully drawn off from the tar, and washed with water. Slaked lime is then added and a current of steam passed through the oil in order to carry off by distillation all the more volatile and odorous liquids. This last, says Selligue, is the most important part of my process, for if this very inflammable portion were allowed to remain in the oil, one could not use the latter in ordinary lamps *à courant d'air.* * * * This patent it should be observed claims only to be an improvement upon that of Blum and Moneuse (*vid. Supra*). Selligue asserts, however, that coal-oil had never before been prepared in such a manner that

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* See seven patents in *Brevets d'Invention*, lxx, 269. Of these patents two are dated 1834; two, 1835; and three, 1836. For a description of his process of gas-making see also *Bulletin de la Société d'Encouragement*, Oct. 1838, p. 396; or Dingler's *Polytechnisches Journal*, lxxi, 29.

† *Comptes Rendus*, 1837, iv, 969.

‡ Dingler's *Polytechnisches Journal*, lxviii, 201; from *Bulletin de la Société d'Encouragement*, Dec. 1837, p. 493.

§ *Comptes Rendus*, 1838, vii, 897.

‖ *Comptes Rendus*, x, 861; also in Dingler's *Polytechnisches Journal*, lxxvii, 137.

¶ *Brevets d'Invention*, lxviii, 395.

** The term "direct illumination" is constantly used by Selligue in contradistinction to the indirect use of the oil in his process of gas-making.

it was fit for use in common lamps. This has, indeed, he says, been the subject of many researches, but no one has hitherto succeeded in avoiding the empyreumatic odor, and the very inflammable products which caused the oil to rise too quickly to the summit of the wick. He goes on to define the difference between his purified oil and the crude oil obtained directly from shale. On the 27th of March, 1839, Selligue specifies certain additions and improvements to the preceding patent. I should add, he says, that I now divide the products of distillation into four distinct parts, which afford me every facility for employing these products in the arts and for domestic economy. In these divisions there are indeed some anomalies which arise from differences in the shales, &c. which I treat; but the following products are always obtained:

I. A light, volatile oil more or less odorous according to the source from which it is derived. * * * This can be used in painting, for dissolving resins, &c., for lighting by vaporising it (it being very volatile) or for the production of gas according to my system.

II. A fat oil only slightly volatile, and having but little odor; this can be used for domestic purposes in ordinary lamps with or without admixture of animal or vegetable oils.

III. A fatty substance almost odorless, possessing all the properties of the fats, and well adapted for use in the arts. It can also be used for lighting, either by mixing it with light oils or by decomposing it for the production of gas. It can moreover be used for soap* since it saponifies very well, and being without odor affords a very good soap; with ammonia the fat forms a sort of pomade.

IV. An odorless pitch of great purity and tenacity, suitable for preparing a black solid varnish for preserving wood, iron-work, &c. * * *

In 1839, Selligue† in alluding to the use of his oils in the treatment of cutaneous diseases speaks of the three large establishments for the distillation of bituminous shale which he has erected in the Department Saone et Loire, and mentions the fact that the oil (crude?) is furnished at the rate of about two cents [ten centimes] per pound.

The question of price is again discussed a few years later, when Selligue‡ says: it has been stated that crude shale oil costs only $1 50 per 100 pounds, and that it contains 60 per cent of a very light volatile ethereal oil well suited to afford light, as well as 40 per cent of a fat substance. Now since 1837, I have extracted more than 4,000,000 pounds of oil from bituminous shale, but the oil (crude?) costs 20 cents a gallon (22 frs. the hectolitre) or even 27 cents when delivered in Paris. From every hundred measures of the crude oil are obtained (by distillation) 20 measures of volatile oil boiling at 100° C.=212° F.; 30 measures of less volatile oil boiling at 150° to 260° C.=302° to 500° F.; 14 measures of an oil containing paraffine, and 28 measures of fat—five measures being lost. In purifying these products a further portion is lost.

The clearest of all Selligue's specifications, however, is that of the patent granted to him March 19, 1845§ for the distillation of bituminous shales and sandstones.

After describing the various forms of apparatus used in distilling, into one of which superheated steam was introduced, he enumerates the products of distillation as follows: I. A white, almost odorless, very limpid mineral oil—somewhat soluble in alcohol—which may be used as a solvent, or for purposes of illumination in suitable lamps, &c.

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* This "soap," (emulsion) is described more fully in the sequel.

† *Comptes Rendus*, ix, 140; also *Annalen der Pharmacie*, von Wœhler u. Liebig, xxxii, 123.

‡ Dingler's *Polytechnisches Journal*, xci, 193; from the *Moniteur Industriel*, 1843, No. 770.

§ *Brevets d'Invention*, [new series, (loi, du 5 Juillet, 1844,)] iv, 30.

II. A sparingly volatile mineral oil of sp. gr. 0·84 to 0·87, of a light lemon color, perfectly limpid, almost odorless, never becoming rancid, and susceptible of being burned in ordinary oil lamps, of constant level *à reservoir superieur*, with double current of air—a slight modification of the form of the chimney and burner being alone necessary. This oil can also be mixed with the animal or vegetable oils. Oils thus prepared do not readily become rancid, nor do they congeal easily when subjected to cold.

III. A fat mineral oil, liquid at the same temperature as olive oil. This oil contains a little paraffine; it is peculiarly well adapted for lubricating machinery, and has an advantage over olive and other vegetable oils, or neats-foot oil in that it preserves its unctuosity when in contact with metals and does not dry up. It saponifies easily, and forms several compounds with ammonia.

IV. From the oils Nos, I, II, and III, I extract a red coloring matter which can be used in various arts.

V. White crystalline paraffine which needs but little treatment in order to be fit for making candles; this substance does not occur in very large proportion in the crude oil, and the proportion varies according to the different mineral substances upon which I operate. There is but little of it in petroleum, and in the oil obtained from bituminous limestone. I often leave a great part of the paraffine in the fat oil and in the grease in order that these may be of superior quality.

VI. Grease. This grease is superior to that of animals for lubricating machinery, and for many other purposes, since it does not become rancid, and remains unctuous when in contact with metals.

VII. Perfectly black pitch—very "drying"—suitable for preserving wood, metals, &c.

VIII. An alkaline soap obtained by treating the oils with alkalies.

IX. Sulphate of ammonia. X. Manure prepared by mixing the ammoniacal liquor, or the blood of animals, with the crushed fixed residue (coke) of the shale. XI. Sulphate of alumina from the residue of the shale. F. H. S.

In describing the methods of purification proposed by Selligue, we shall make no attempt to follow their various details, our limited space compelling us to content ourselves with only the broadest generalities. Selligue sets forth at length two methods: 1st. A cold treatment which consists in agitating the oil with sulphuric, muriatic, or nitric acid. This agitation should be thorough, he says, and should be continued for a longer or shorter time according to the nature and quantity of the matter treated. Here follows a description of his agitators. After several hours' repose, the oil may be decanted, except from muriatic acid in which case more time and a larger amount of acid is required. After the oil has been thus separated from the deposit of tar, the acid remaining in it must be neutralized by means of an alkali. I prefer, says Selligue, to employ the lye of soap-boilers marking 36° to 38° [B.?], since it is easy of application, and produces a sure effect; I thus precipitate together the coloring matter and tar which would otherwise have remained in the oil. The oil is then decanted: if it is the first distillation of the crude oil I do not allow the mixture to subside entirely, preferring to leave a portion of the alkali mixed with the oil, and to distil off only ¾ths of the latter. * * * When the soda lye—in quantity slightly greater than is necessary to neutralize the acid—is added, the liquid must be agitated violently in order that each particle of the oil may be brought in contact with the alkali; this agitation must be continued until the color of the oil undergoes change.

The oil becomes less odorous and less highly colored after each such "cold treatment."

After having been allowed to separate from the lye, the oil is decanted off; if it has not lost much of its color the process has been badly conducted. It

should be stated that the oil must not be agitated several times with the alkali, for, by so doing, the dark color of the oil would be restored. * * * As for the residues of the soda treatment, continues Selligue, they should be allowed to stand at rest during some days beneath a portion of oil, which will protect them from contact with the air; the clear lye at the bottom being then drawn off may be used for other operations, while the remainder is a soap, containing excess of alkali. By adding to it a little grease a soap can be made, or by adding water, grease may be separated. This grease is similar to that used for wagons.

2d. A warm treatment which follows the cold, and consists of a series of fractional distillations,—special operations for the purification of the "light-stuffs," being resorted to. For the details of these we must refer to the original specification of Selligue—a truly classical document which should be read by every one interested in the manufacture of coal-oils.* Nor will our limited space permit us to cite the detailed "example" of his treatment which Selligue has described. We trust that we have already written enough to enable the reader to judge whether or no Selligue understood his business.

As for paraffine, Selligue obtained it by subjecting the oil to a low temperature in order that this substance might crystallize. The mixed oil and paraffine was then thrown upon fine metallic filters through which the oil flowed while the paraffine was separated. Or one may separate, he says, the oil by imbibition, but this occasions a great loss of oil and also requires more labor. * * With this specification the scientific discussion of the subject by Selligue appears to have ceased, yet in the same year he replies† to a note published by Chenot‡ who asserted that the oil of shale often contains arsenic, denying that arsenic can be found in the products from his own establishments. He again describes the locality and geological position of his shale, the method of distillation employed,—how the temperature is gradually elevated, &c.

This is of interest as showing that the manufacture of coal-oil in France was no ephemeral fancy, but for many years was a well established branch of industry. In this connection the scientific research, upon the commercial products of the distillation of bituminous shale, of Saint-Evre§ should also be mentioned. Contemporaneous with Selligue we find other inventors occupied with the same subject. Thus Holthorp,‖ in 1841, claims that he has first discovered a means of purifying the fluid substance, which he calls "schiste," resulting from the distillation of coal or of bitumen. His attention was evidently chiefly devoted to the volatile naphthas, but he also obtained paraffine.

Guillard Meynier,¶ in 1842, speaks of the fixed oil from shale, telling us that it may be used for lighting or lubricating and that paraffine may be separated when the oil is cooled or treated with alcohol.

In the same year Bonnet** in treating of liquids suitable for lighting incidentally mentions eupion and paraffine.

Nor should we omit to mention the very interesting article upon *Hydrocarbures Liquides*, by A. Mallet (in Laboulaye's Dictionnaire des Arts et Manufactures, 2d Ed., Paris, 1854††), in which Selligue's processes are incidentally described. After discussing in detail the light volatile products obtained by distilling coal-tar, he says, we have still to speak of the carbo-hydrogens from shales; a branch of industry which we owe entirely to Selligue—cut off,

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* A tolerably accurate English translation of this important patent may be found in the specification of M. A. B. B. Du Buisson, 1845; specification No. 10,726 of the English Patent Office.

† *Comptes Rendus*, 1845, xx, 573.

‡ *Ibid*, xx, 306.

§ *Comptes Rendus*. 1849, xxix, 339.

‖ *Brevets d'Invention*, liii, 263.

¶ *Brevets d'Invention*, lxxviii, 91.

** *Ibid*, lxxix, 63.

†† A portion of this article, which directly refers for the most part only to the volatile products suitable for "burning fluids," which may be obtained in any way from coal, is also contained in Dingler's *Polytechnisches Journal*, 1847, cvi, 128.

alas! prematurely, in the midst of his career so full of discoveries and of useful works. As is well known, he obtained by distilling shales from the environs of Autun: I, volatile ethereal oils, II, fixed oils, III, oils combined with paraffine from which he prepared grease for carriages, IV, paraffine suitable for making candles, &c. Among all these bodies, Mallet continues, we have only to occupy ourselves with the volatile oils. Further on M. remarks that the acid and alkaline treatment used by Selligue is similar to that proposed by Barral for products from coal-tar. Thus far, says Mallet, these hydro-carbons have found no application,* partly on account of their insupportable odor when not purified and partly on account of their high price—about $10·00 the hundred lbs.—when purified.

We have been at no pains to ascertain whether the industrial distillation of shales, so well grounded by Selligue, has been continued in France without interruption up to the present time, for we know of no reason to doubt the fact. Certain it is that coal-oils produced by French manufactories were exhibited, at the Exposition Universelle at Paris in 1855, and likewise in 1851 at London.†

To any one familiar with the extreme slowness with which the practical applications of chemistry are even now imparted to, and recorded by, scientific writers, it would have been no matter of surprise if the results obtained by Selligue had remained uncopied upon the records of the French patent office. Such however was not the case. From the preceding citations it will be seen that his results were published in various well known journals and were widely diffused. Dumas, in his *Traité de Chimie Appliquée aux Arts*,‡ expressly calls attention to them. They are also noticed in the *Handwörterbuch der reinen und angewandten Chemie, von* Liebig, Poggendorff u. Wœhler, 1844, iii. 364. What we cannot explain is the apparent ignorance of these facts which was exhibited by several of the leading chemists of Great Britain on the occasion, of a trial,§ Young, *v.* White and others held in June, 1854, in the Court of Queen's Bench before Lord Chief Justice Campbell.

Several patents for the production of oils [coal-oils] from bituminous substances were meanwhile obtained in England. Butler,‖ for example, in describing his "improvements in the manufacture of oil and gas" proposes to distil bituminous shales, &c. for the purpose of obtaining oil and gas free from naphthaline. The shale, best after wetting it with water if the principal object is to obtain oil, is distilled in common gas retorts under which a gentle fire is lighted. As soon as oil begins to flow over freely the fire is to be increased and the retorts brought to a red heat; a large quantity of gas is thus obtained which is collected in a gas holder. The rough oils, as Butler informs us, may be purified by washing with sulphuric acid, filtration, &c., or they may be used in the rough state for making oil-gas. The oils in their rough state are often found entirely free from oxygen, and if obtained by the process described never contain so much as is contained in the coal-tar obtained in the coal-gas works where the coal is thrown into retorts already brought to a red heat. These oils in their rough state are further distinguished from coal-tar by their containing no naphthaline. Moreover the less volatile part of the

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* It will be observed by the reader of Mallet's treatise that he is interested only in a single branch of the subject, viz., the volatile naphthas—"light stuffs," just as we are here giving prominence to another portion of it, viz., the fixed, or paraffine-oil; and that he holds the naphthas from shale in small repute, since in his opinion they can never compete in the matter of cost with those from coal tar.

† A. U. Morean (No. 1361, Cat. 9), *Bas-Rhin.*

‡ Paris, 1844, t. vii, p. 390; also t. iii, p. 315 of the Liege edition; and B. vii, S. 510 of the German translation.

§ Reported in Barlow's London Journal of Gas Lighting, Aug. 10, 1854, vol. iii, p. 508.

‖ Patent granted Jan. 29, 1833. Specification No. 6375 of the English Patent Office.

oil [No. 2] offers another characteristic feature; if after being drawn off and distilled, and if in this latter process the more volatile or first proceeds, say one half of the quantity acted upon, be set apart and the remaining half exposed to a low temperature, there will soon appear in this part of the distilled oil small flakes of a white, odorless, and light substance which is a compound of carbon and hydrogen [paraffine]. The familiarity with the subject, somewhat remarkable in view of the early date of his patent, which Butler exhibits cannot fail to strike the reader. This inventor was however unfortunate in the idea of trying to make at the same time oil and gas—in endeavoring to reconcile two antagonistic processes.

In 1841, Sept. 4, Count de Hompesch of Prussia* specified certain "improvements in obtaining oils and other products from bituminous matters."† It is well known, he says, that oils may be obtained from these substances but from the imperfection of the processes now used the quantity obtained is small, the quality inferior, and the smell noxious. My invention consists in an improved process, whereby I increase the quantity, improve the quality, and remove or greatly modify the smell. I have found by experiment, he continues, that the oil from shale, &c., possesses three different characters which may be called essential oil, intermediary fat oil, and thick oil, and these oils I separate by means of peculiar apparatus—which he describes in detail. In distilling shales heat is applied until the temperature reaches 100° R. = 257° F., at which temperature essential oil will pass over. The charge, after having been subjected to this temperature for half an hour, is pushed forward in the retort which is now subjected to a heat of 200° R. = 482° F., by which increased heat the intermediary or fat oil is obtained. After having subjected the charge to this increased temperature for half an hour the workmen again pushes the charge further on in the retort where it becomes of a red heat; the vapor now given off yields the thick oil. The carbonization is now complete; and I obtain these three separate oils by the gradual increase of the heat; and I effect this distillation without decomposition of the substance, the vapors escaping from the retort as fast as they are formed.

The essential oil is separated from the fat oil by exposing the mixture to a current of steam by which the more volatile oil is carried off. The oil [fixed] thus prepared must be filtered and is then ready for application to all kinds of machinery, being very fat, works without friction and leaves no sediment. The essential oil is collected and subjected to further treatment.

The specification of Du Buisson‡ for improvement in the distillation of bituminous substances, is an almost literal translation of Selligue's last patent. Indeed, Du Buisson tells us that the extensive works at Autun, Department of the Saone and Loire, France, are partly his property and that he has the management of them as chemist. He affirms moreover that the most important results have there been attained — results which place the distillation and treatment of schistus among the most useful and productive of chemical manufactures.

Since we have already extracted largely from Selligue's specification it is unnecessary to cite more of it here. It is a little curious that this most important patent is not mentioned in Dr. Antisell's "list of English Patents" (p. 141).

The well known attempts to prepare paraffine and oils from peat§ need not be discussed here. Another patent, not mentioned in Dr. A.'s list, is that of

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* Specification No. 9060 of the English Patent Office.

† In a "memorandum of alteration," dated July 5, 1842, de Hompesch claims the right of distilling "bituminous schists, shales, or slates, or other rocks or minerals containing bitumen or bituminous substances."

‡ Dated June 23, 1845. Specification No. 10,726 of the English Patent Office.

§ Antisell, p. 85; compare Rees Reece's patent dated Jan. 23, 1849. Specification 12,436 of the English Patent Office.

George Michiels.* It is peculiarly interesting since a portion of it relates to the preparation of oils from caking coals. Michiels proposes in fact to prepare coke from bituminous coals, and from mixtures of such coals with anthracite, by moistening the powdered coal with water and introducing it—in charges of six tons—into brick retorts furnished with ordinary condensing apparatus and other appliances. The retorts are then heated as if it were intended to produce gas, with this difference, that the temperature for the first fifty hours should not exceed nascent red heat, or 964° F.; after that time it should be increased progressively until it attains a clear red heat, which would be about the ninety-sixth hour, I should remark, continues Michiels, that about the sixtieth hour I shut off the communication between the retort and the condensor by closing the hydraulic valves, and at the same time open the valve on top of the retort, &c., so as to allow the air to enter, which burns the hydrocarburets [now being evolved] and the products of that combustion heat the retort, &c. in passing through the flues which surround the retort. * * * I thus obtain coke, ammoniacal liquors and liquid hydro-carburets. These "hydro-carburets" were repeatedly distilled by M. in order to obtain as much light volatile oil as possible, A heavy yellow oil of density 0·911, or lower, was also obtained which according to M. will be found applicable to many useful purposes, and is suitable for his principle object of turning into gas.

Further on (p. 15 of his specification) Michiels explains that this oil is well adapted for manufacturing gas upon a small scale, since the gas prepared from it requires no purification, and since it can be used in any of the ordinary apparatus for making gas from camphene, oil, or resin. In a word, he proposed using it just as rosin oil is now so largely employed by private gas-works in this country, or as Boscary and Butler had used the same coal-oil before him.

We pass† to a consideration of the well known labors of Mr. James Young of Glasgow.‡ From evidence brought forward in the trial already cited it appears that Mr. Young's attention was called in 1847 to a mineral oil [petroleum] found exuding from a coal pit at Riddings in Derbyshire. From it he obtained a good lubricating oil which he continued to prepare as long as his supply of petroleum lasted. Occupied as he was with the subject it can surprise no one that he should soon have turned his attention to the distillation of the highly bituminous mineral of Torbane-hill, now known as Boghead coal in England and in this country, which was introduced to public notice in 1850.§ From this substance Young was enabled to prepare a much larger amount of oil per ton of mineral than had been obtained by any of his predecessors. To the discovery of the vast source of an admirable raw material which the Boghead mine furnished is evidently due the immense increase in the production, and of course consumption, of coal-oil which immediately ensued. To this we say, more than to anything else is to be attributed the rise and progress, during the past few years, of the almost innumerable manufactories of coal-oil on the continent of Europe and in our own country. From the impetus thus given, a branch of industry which had long been, comparatively speaking, of only local importance soon attained an enormous development.‖

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* Granted April 30, 1850. Specification No. 13,066 of the English Patent Office.

† Making no pretence, be it understood, that we have been able to collect all that has been published upon the subject before 1850.

‡ Patent dated Oct. 7, 1850.

§ According to Mr. T. G. Barlow, *London Journal of Gas Lighting*, iii, 519.

‖ We cannot, in this connection, forbear quoting the following pertinent remarks from Lord Campbell's charge to the jury in the case—Young *v.* White and others (see *London Journal of Gas Lighting*, iii, 521)—already cited.

"And this brings me to an observation," says his Lordship, "which I meant to make, and which I should have been sorry if I had forgotton, which is this—that it was the discovery of this Boghead coal that seems to have given the great value

Let it be distinctly understood that we would in no wise detract from the real merit of Mr. Young. Uniting, as he does, no small share of chemical knowledge with the cautious, untiring energy of his countrymen, few men could have been found better qualified to grasp the golden opportunity of which he so fortunately availed himself. His name must ever remain associated with those of the distinguished observers from whose labors this most important branch of industry has resulted. It is Dr. Antisell only whom we blame for his incorrect and partial "history." When, for example (on p. 14), Dr. A. tells us that: "only since the year 1850 has the manufacture of paraffine from pit-coal, turf and bituminous shales succeeded as an art. The first manufacture was that of James Young in Manchester, by whose process, from 100 parts of Cannel-coal 40 per cent of oil and 10 per cent of paraffine could be obtained." He makes a statement which is grossly exaggerated—if not *entirely* at variance with fact—as our readers must already have perceived.

We willingly quote what follows: "In thus showing [*i. e.*, dogmatically *asserting*] that the practical manufacture of oils from coal is due to James Young, it may not be amiss to call attention to what it was which he produced from coals by distillation. He claimed the production of paraffine oils—not the production of naphtha or benzule [benzol?], nor naphthalin, but paraffine and its congeners: this involves the slower distillation of coals at a lower temperature than had been hitherto effected, and this novelty in practice was followed by the novel result of a copious production of isomeric liquid hydrocarbons; so that really two great results were first demonstrated, practically by the operation of Young's process, namely—1st, That coal was a material from which liquids could be manufactured economically, as tar, bitumens, and schists had been hitherto employed; and 2nd, That the liquids so formed were paraffine-containing compounds." Having merely to suggest that the sentence might have been more tersely put. For in truth it means only—if it means anything—that in the opinion of Dr. A., Mr. Young was the first person who distilled coal [on a manufacturing scale?] at comparatively low temperatures. What Dr. Antisell's private views regarding "low temperature" or "practical" may be, we are ignorant. But we do know that when, 30 years ago, Reichenbach distilled quantities of coal of 75 lbs. weight each, and exercised the greatest care in maintaining the temperature of his retort at as low a degree as was admissible, as he has most minutely described in the memoirs which we have already cited;—when he obtained paraffine and eupion as results of his operation; he most certainly demonstrated the practicability and the manner of preparing both paraffine and "paraffine-oil."

All this however does not appear to satisfy Dr. A. in the least degree, who repeatedly assures his readers that the manufacture of oil from *coal* dates from the patent of Mr. Young. Since our author has seen fit to dwell at length upon this point and to devote so much space to its discussion we may be pardoned for referring to it here.

As is well known the term "coal" is applied in common language to a great variety of mineral combustibles no two kinds of which are precisely alike while some sorts are exceedingly unlike others. The term is at best merely conventional; used, in lack of any better one, to designate substances with the real nature of which we are still almost entirely ignorant.

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to paraffine, because until then I do not find it was obtained in such quantities as really were of any considerable value; but the Boghead coal now being discovered, and this schist or coal being discovered, which is of very rich quality, and having a great deal of what is the essential part of the paraffine; from that time it has become much more important; and that may explain why, although the mode of obtaining paraffine was before well known, it should not have been put in practice because it would not appear that it could be put into practice with much profit or benefit, unless you had such a substance as Boghead coal on which you could operate."

In confirmation of this view compare also: Payen, *Précis de Chimie Industrielle*, 4e Ed.. Paris, Hâtchette. 1859. t. ii, p. 685.

With the flint-like anthracite of Wales, the beautiful Albert coal*—but a step removed from asphaltum—of Hillsboro, New Brunswick; our common lignites, frequently shading into peat, and the bituminous shales as frequently passing by insensible gradations into common slate, as points upon its extreme limit, we have within the circumference of the circle an infinite number of substances, shading into each other by scarcely perceptible degrees,—all of which are, in technological language at least, varieties of *coal*. The "amplitude of variation" which this species, or rather this term, enjoys is indeed so great that it would be a matter of no small difficulty to choose any single member of the medley as a central point, or even to conceive of an ideal coal to which all other varieties should be referred. In attempting any such selection a native of one of our sea-board states would assuredly lean towards anthracite; the South-German towards his excellent lignites; the Scotchman towards his cannel; while Newcastle would claim a proverbial right of precedent. We would, for our own part, vote for the last named, or some other good caking coal, capable of furnishing both gas and serviceable coke, and of being used for an infinite variety of purposes. Starting from this then as a type, observe, that as we pass towards the cannels, the different varieties of coal become better and better suited for the manufacture of gas or oil, *i. e.*, they contain more and more hydrogenous compounds. The appearance of the mineral meanwhile approaching more and more closely to that of slate, while at the same time the value of the fixed carbonaceous residue becomes less and less, soon ceasing to be "coke" at all, but rather a more or less carbonaceous slate. At length a maximum of hydrogenous matter is reached as in the case of Boghead coal, a slaty substance, the fixed residue from the distillation of which is a slightly carbonaceous stone, valueless as fuel and useful only, as a substitute for bone-black, for purposes of disinfection or decolorizing liquids, uses to which the residues of the French shales have long been applied. Beyond this maximum, as the amount of gas and oil-producing substances diminishes, and the amount of earthy matter increases,—taking the place of the fixed carbon in our typical caking coal, we pass into "bituminous shales," and these become less and less bituminous until at length we reach common clay slate containing no organic matter whatsoever. We have here traced no fancy sketch. That the "cannel coals" thus gradually pass into "bituminous shales" is now well enough known, at least to gas engineers and other practical observers. It would not for that matter be exceedingly difficult to obtain a continuous series of specimens exhibiting this almost insensible gradation. Now did Mr. Young devote his attention to the distillation of caking coals similar to our typical Newcastle? By no means! On the contrary we find him occupied with a mineral which was called indifferently "shale" or "coal," until it was in 1853 decided in a Scottish court that it should henceforth be legally known as coal.†

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* On page 18 of Dr. A.'s work the following remark occurs. "In one respect they [bitumens] differ from coal. In no case can an organic tissue or structure be demonstrated when they are examined under the microscope. Viewed in this light the mineral found at the Albert mine, New Brunswick, should be classed as a bitumen since Dr. J. Leidy was unable to detect any trace of structure in its mass." We cannot understand the motive of our author in thus again dragging to light this negative result, for it is perfectly well known to the scientific men of America that Prof. J. Bacon detected the existence of vegetable structure in the interior of masses of the Hillsboro coal. See *Reports on the Geological Relations, chemical analyses, and microscopic examination of the coal of the Albert Coal Mining Co., situated in Hillsboro, Albert Co., N. B*, by Chas. T. Jackson, M D. New York: printed by Nesbitt, 1851, p. 30; compare this Journal, [2], xiii, 276.

† We had supposed, when the above was written, that the decision of this court had been sustained. That in this we were mistaken appears from the following, which we extract from a statement in a late number of the *London Journal of Gas*

We would cast no reflection upon the judgment rendered in this famous suit. Looking at it as a mere matter of equity, depending upon the business relations of the parties at issue, this verdict was in our own opinion, just. But the fact of this mineral being, or not being, called a *coal*, does not in the least degree prevent it from being *also a shale*; and that it is more nearly related to the shales than to the coals is believed by a large proportion of those who are intimately acquainted with it, be they scientific or practical men. We have no space to discuss at greater length this quibble of Dr. Antisell's—which, however excusable it might have been in a retained attorney or solicitor of patents, is anything but becoming to the chemical professor or the historian—being content to refer the reader to the published reports of the trial just mentioned. We will here cite only a few lines* descriptive of Selligue's mineral: "The quantity of oily matter in these shales is very variable and often very

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*Lighting* (Jan. 17th, 1860. vol. ix, p. 41), received as this article is going through the press.

"SETTLEMENT OF THE GREAT TORBANE-HILL CASE.

We have been favored with the following particulars connected with the well known case, the 'Bathgate or Boghead Gas Coal *alias* the Torbane-hill Mineral,' which has lasted upwards of seven years, having passed through several phases in the Supreme Law Courts of Scotland and England. A compromise was finally come to on Wednesday last, the eleventh current. It is embodied in a minute of agreement between Mr. and Mrs. Gillepsie of Torbane-hill, of the first part, and Messrs. James Russel and Son, and James Russel, Esq., of Blackbraes, of the second part.

The preamble of the minute of agreement, which itself consists of twelve articles, is as follows:

'The said parties, considering that disputes and differences have arisen between them and a lengthened litigation has taken place, with respect to the missives of agreement for a lease of certain minerals in the lands of Torbane-hill, entered into betwixt the said first party hereto on the one part, and the said company of James Russel and Son, and individual partners thereof, on the other part, and dated the 30th of March and 1st of April, 1850; and both parties being now desirous that the said litigation should be brought to an end, and all disputes and differences between them amicably adjusted and settled, they have agreed, and hereby mutually agree and bind themselves as follows:'—

The first two articles provide that the actions at present depending shall be abandoned, as a consequence of the execution of the minute.

The third article provides that each party pay their own expenses.

The fourth article, which has for title 'Name of Mineral,' is both an important and curious one—important in a scientific point of view, and curious as illustrative of the pertinacity with which either party have clung to their own views. The article is as follows:—'Whereas the second party have been, and are, working in the said lands of Torbane-hill, and disposing of, under the name of Bathgate or Boghead gas, parrot, or cannel coal, a mineral which they, the second party, deemed and deem to be a parrot or cannel coal, and which the first party deemed and deem to be a new mineral substance, having an argillaceous base, and to be of so peculiar a nature as to constitute it in truth a new and very peculiar variety of bituminous schist, slate, or clay, and have been for some time in use to call 'the Torbane-hill Mineral'; it is hereby agreed that, throughout the remainder of these presents, where the mineral in question is named, it shall be called for the sake of brevity the disputed mineral.'

Article fifth relates to the subject of a portion of Torbane-hill which was reserved from the operation of the mineral lease, and by this article 'the disputed mineral,' as we now call it, contained in the reserved portion of the estate, may be worked or let by the proprietors, without the danger of any obstruction being offered by the second party in the agreement." * * *

* From Dufrénoy et Elie de Beaumont's Explication de la Carte Géologique de la France. Paris, Imp. Royale, 1841. t. i, p. 673.

considerable. According to M. Xardel some rare samples exist which afford even 45 @ 50 per cent; * * * other specimens afford 20 @ 25 per cent. The beds which are worked, or are capable of being worked, yield from 5 to 9 per cent." [p. 675.]—Again [p. 676], "The impressions of fossils, so common in the shales of d'Igornay, occur in the poorer shales. The rich shales, on the contrary, often contain vegetable remains analagous to those commonly found in the coal measures. Perhaps the beds of rich shale are in a manner the representatives of coal-beds; it is to be remarked that in the shale which yields 9 per cent of oil its sheets are covered with a multitude of shining (*miroirtantes*), lenticular veins, having a waxy fracture, which by their aspect and manner of burning recall the variety of coal which is called *cannel coal*." —Leaving it for our readers to answer the question; how far removed in anything but productiveness is the "coal" (Boghead) upon which Mr. Young has operated from the "*shale*" distilled by M. Selligue?

It may not be amiss to mention the fact that upon the continent of Europe the Boghead mineral is almost universally called, not coal, but shale. A fact with which the reader can readily enough familiarize himself by consulting the German chemical journals of the last eight or ten years. In proof of it we cite only the following:* "The recent verdict in the celebrated Torbane-hill-mineral case appears to be contrary to the scientific opinions held in Germany, as proof of which we have a case in point, and which, although not at the time known in this country, was officially decided upon in Berlin previous to the trial coming on in Scotland, which terminated on the 4th of August last. It appears that in Frankfort-on-the-Main there has, for some time past, been in existence a company for lighting the streets and houses by gas from oil, resin, &c. A rival English company contracted to light with coal-gas; and to give both fair play, it was decided that the latter company should be confined to the use of coal alone. Mr. Engelhard, the manager of the Oil (Resin) Gas Company, having heard of the Boghead and Torbane mineral, obtained specimens, and having found they produced excellent gas, gave an order for a large consignment which reached Frankfort *viâ* Rotterdam, through a Dutch agent. This was entered at the Custom-house as cannel coal, much to the annoyance of Mr. Engelhard, who was no more at liberty to make gas from coal than his rivals were to make it of anything else but coal. He was, however, prevented from the necessity of a trial at law, for the officials did not feel themselves justified in charging the duty as coal, although, as other mineral, it would pass free, and applied to higher authorities for instruction. These parties were as much at a loss as their inferiors, and the case was eventually transferred to the Central Board of Customs at Berlin, the last court of appeal of the Prussian *Zollverein*, where all disputed questions in the German States are settled. Scientific men, connected with the board, examined the Boghead and Torbane mineral and decided that it was *not* coal, but *bituminous shale*, which is said to be the general opinion among German chemists. It has been admitted into Germany, duty free, and Frankfort is now partially lighted with gas from this mineral, charged for as resin or oil gas. It is described as a clay containing bitumen, and producing oil when heated. At all events, we may take this German decision as impartial as, had it been admitted as cannel coal it would have been subject to a duty varying from 1*s.* to 1*s.* 6*d.* per ton."

In connection with the question of the products of the distillation of *coal* which Dr. A. would have us believe so entirely new to the world and to this country in particular, we cite the following from The *Encyclopædia of Chemistry*, by James C. Booth and Campbell Morfit. 8vo, Philadelphia, Baird, 1850, p. 461. Article, Coal: paragraph, "products of dry distillation."

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* See *London Journal of Gas Lighting*, Oct., 1853, iii, 256; from *London Mining Journal*.

"These products [of the dry distillation of coal] are somewhat analogous to those derived from wood, and some are identical with them. * * * The liquid products consist of various bodies closely allied to petroleum, and the solids *Naphthaline* and *Paraffine*. The relative proportions of these products vary with the temperature. The lower the heat employed, the less gas, and the more solids and liquids are produced; the higher the temperature the greater is the quantity of carburetted hydrogen." Before closing this sketch we must refer to and correct a palpable error of Reichenbach's* which has been cited by Dr. Antisell (p. 14), from whom we quote it: "So remained paraffine until this hour [date of Y.'s patent], a beautiful item in the collection of chemical preparations; but it has never escaped from the rooms of the scientific man."

Upon the reader who has followed us thus far we need not urge that the above statement is incorrect. As an offset to it we cite the following:†

"In the Parisian Industrial Exhibition for 1839 Selligue exhibited: 1st—Bituminous shale, then fluid bitumen [crude oil], mineral grease, crude and refined (the former at 50 fr. the 100 kilog. [= $5.00 per 100 lbs.]), also *mineral wax* [paraffine] crude and refined (the former at 125 fr., the latter at 180 fr. [= respectively 12½ and 18 dollars per 100 lbs]). The purified mineral wax was *b*eautifully white but the candles made of it had a soiled appearance." V. Hermann (now, according to Wagner, councillor of State in Munich goes) on to assert that "if these fatty products can be prepared economically they belong to the most important objects of the Exhibition."

It would be foreign to our purpose were we to attempt to trace the recent history of the art of manufacturing coal-oil, even if our space allowed of it. During the past few years a large number of papers‡ on the subject have been published in the Scientific Journals of Germany; while several recent works upon the materials used for producing light have each devoted a separate chapter to its description. A few special treatises have also been published of which the following is a, doubtless very incomplete, list.—§

Uhlenhuth, Ed. *Handbuch der Photogen- und Paraffin-Fabrikation aus Torf, Braunkohle und bituminösem Schiefer nach den neuesten Versuchen und Erfahrungen. Quedlinburg, Basse*, 1858.

Mueller, Carl, Georg, *Die trockene Destillation und die hauptsächlichsten auf ihr beruhenden Industriezweige.* Leipzig, Barth, 1858.

Danckwort, Meitzendorff *und* Wernecke. [Committee of the Magdeburg *Gewerbeverein.*] *Ueber das Photogen oder Mineralœl, so wie die ihm*

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* Erdmann's Journal für praktische Chemie, lxiii, 63. Did our space allow, we would gladly transcribe the whole of this article—an English translation of which may be found in the London, Edinburgh and Dublin Philosophical Magazine, [4.] viii, 463—in proof of our assertion that the present widely-spread manufacture of coal-oil and paraffine is mainly due to the comparatively recent discovery of rich stores of highly bituminous substances.

† From v. Hermann's *Die Industrie Ausstellung zu Paris im Jahre*, 1839, *Nürnberg*, 1840. p. 147;—in Wagner's *Jahresbericht ueber die Fortschritte der chemischen Technologie*, 1855, i. 416.

‡ Very complete synopses of these may be found in Wagner's *Jahresbericht*, four volumes of which have thus far been published. For references to the recent admirable *scientific* researches of Greville Williams, De la Rue, and others, which have been chiefly confined however to the more volatile portions of the oil and to the basic compounds which occur in it, see Liebig and Kopp's *Jahresbericht der Chemie, u. s. w.*

§ Small as this list is, it will nevertheless recall to the mind of the reader the modest lines with which Dr. Antisell's preface commences, namely these: "the present little treatise is the first published monograph on the art of distilling oils from minerals containing Bitumen."

*ähnlichen Leuchtstoffe, in Bezug auf ihre Feuergefährlichkeit und ihre Anwendung.* Magdeburg, 1856.

Also the insignificant brochure of SCHRADER, F. W. *Ueber die industrielle und national-ökonomische Bedeutsamkeit der Gewinnung von Chemikalien insbesondere des Paraffin's und Photogen's aus dem Kohlentheer, u. s. w.* Aschersleben, Beyer, 1856.

This article must here close. Leaving unnoticed several inaccuracies which we had intended to discuss we will dismiss the subject with two brief quotations. The first from Dr. Antisell's book, p. 15. "An impression has taken hold of the American manufacturing public that the patent of James Young has no force, as it was not a new invention at the date of the patent; and from the unfavorable effect of that patent upon the actual manufacture of coal-oils in this country, an ill-feeling has been produced against it. That the owners of this patent have not acted wisely by witholding sales and licenses under it until very lately, is to be regretted; but that it was a *bona fide* improvement in an art at the time when it was patented, and that therefore the patent was rightly issued in this country, there can be no shadow of a doubt in the mind of any one who carefully traces the steps of the discovery of the production of photogenic oils from different materials."

The second from Lord Chief Justice Campbell's charge* to the jury in the case already alluded to. "Now gentlemen I direct you, in point of law, that if there were books then [at date of Young's patent, 1850] in circulation in England disclosing this mode of obtaining paraffine and paraffine oil which were known, were accessible, that the patent would be invalid, although Mr. Young never read those books, and although that mode had not been actually put in practice. If there were books in England in circulation, accessible to all who were interested in the subject, which disclosed this, and would instruct them and enable them to obtain the paraffine and the paraffine oil from the distillation of bituminous substances, then Mr. Young's patent would be invalid."

FRANK H. STORER.

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* *Loc. cit.*, p. 520.